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Device for the accurate positioning and stacking of vessels

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Description

The invention concerns a device for the accurate positioning and stacking of vessels, preferably containers.

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It can be used wherever vessels need to be positioned and stacked fully automatically. Positioning can be specified by a central computer unit. The device is particularly useful where work needs to be carried out with little swing and a sensor system which reacts extremely sensitively to tough environmental conditions and is susceptible to disruption, cannot be used.

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Devices for the semi-automatic positioning and stacking of containers are known. The disadvantage of them is that spreader swing is poorly compensated. This is in part due to the difficulty in capturing them once the spreader is lowered, and in part due to precise correction using a crab being a problem. A container crane system is known from EP-A-0 242 655 which works with a remote detection system for containers; this system operates on the basis of signal reflection (pulsed guide beam transmitter). This requires surfaces which also always reflect the transmitted beam in the desired way. The spreader's swing is balanced by wedge-shaped swing-absorption surfaces on the spreader and no further clarification is given. Highly precise positioning of the container via the crab cable system seems problematic.

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The role of the invention is therefore to develop a device which eliminates the disadvantage of the state of the art and allows for accurate and rapid positioning of vessels.

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This task is resolved by the first patent claim. Beneficial versions are listed in the secondary claims.

5 The device per the invention for the accurate positioning and stacking of vessels consists of a crane with a low-swing cable shaft between the crab and the load suspension device head, a load suspension device and at least one sensor system to detect the position of a vessel, a fine positioning device on the load suspension device and a computer unit which monitors
10 the automatic operation of the device.

Via obliquely running cables between the lifting mechanism and the load suspension device on either side of the load suspension device, working with the load suspension device
15 causes as little swing as possible. It is advantageous here if the cable angle to the perpendicular is as large as possible.

Image detection is the sensor system used for vessel position detection. This image detection delivers a signal to a
20 computer unit which analyses the signal by comparing it with a reference value. Images of, for example, vessels or container corners can be compared as signals.

It has proved advantageous to use video cameras as image
25 detection as these can transmit a signal to a central computer unit with the fewest disruptive influences possible. The use of infrared and other technologies could also be envisaged for image detection.

30 It has also proved advantageous to arrange these video cameras directly on the load suspension device so that disruptive influences and errors due to excessive vessel distance do not occur.

35 It is also advantageous to arrange four image detection installations, i.e. one image detection installation on each corner of the vessel, on the load suspension device.

Here, the image detection installations can be fixed on the top of the load suspension device and capture the vessel via a

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mirror. Another feasible solution is to arrange the image detection installations on the corners of the load suspension device.

5 To prevent operational disruptions of the image detection installations, for example due to impact, the cameras can be flexibly mounted and attached. Another way of fixing the image detection installation is a telescopic device on the spreader, via which the installation can be extended and
10 retracted.

It is also advantageous to fit on the spreader a device to prevent collisions with other containers or the walls of the warehouse. This can be in the form of a laser, ultrasound sensor or a video camera.

15 For the same purpose, anti-ramming devices can also be attached to the spreader; they can be in the form of rubber buffers or sprung rollers or wheels.

To grasp or stack a vessel absolutely accurately, the crab,
20 which is controlled via a central computer, is first positioned above the vessel to be grasped. Before the corners of the load suspension device are precisely adjusted using the fine positioning device, there is a check as to whether the load suspension device is also perpendicularly under the crab.
25 This is done by an installation on the crab capturing a target mark on the spreader and transmitting its deviation as a signal to the computer. Once rough positioning is complete, the load suspension device with or without new vessels being lifted is lowered using the low-swing cable shaft to around 50
30 cm distance over the vessels to be captured. The now problematic positioning of the load suspension device in the x/y direction and its twisting is effected by the fine positioning device directly on the load suspension device. Fine positioning can be carried out by a locking cylinder
35 which moves the two surfaces of the fine positioning device of the load suspension device against each other in the x/y direction and direction of twist, during which signals to adjust the fine positioning are given by the computer on the basis of the signals obtained via image detection.

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A substantial element of the invention is also that hydraulic cylinders are fitted on the cables such that the cable tension can be altered by extending or retracting the cylinders in such a way as to prevent the load suspension device from swinging. Hydraulic cylinders can be fitted on the cable ends for this purpose. Computer-aided cylinder drive adjustment is advantageous.

The invention presents the advantage of allowing for fully automatic and accurate positioning and stacking of vessels, preferably containers, in which vessel position detection is accurate and problem-free and the vessels can be fine positioned on the load suspension device quickly and highly precisely.

Below the invention is explained using one possible version and eight figures. The figures illustrate:

- Fig. 1 Positioning installation for containers, front view
- Fig. 2 Positioning installation for containers, side view
- Fig. 3 Capture installation to prevent spreader collisions
- Fig. 4 Anti-ramming device on spreader
- Fig. 5 Load swing detection system between crab and spreader
- Fig. 6 Telescopic installation for cameras
- Fig. 7 Flexible suspension for camera on side of spreader
- Fig. 8 Tilted mirror with flexibly attached camera on spreader
- Fig. 9 Positioning installation for container with hydraulic cylinders to prevent swing.

Figure 1 shows a front view of the installation per the invention for the accurate positioning and stacking of containers 18. Bridge 2, which can be moved along the crane track support, is on crane track support 1. Crab 5 is fitted on running wheels 6 on bridge 2, which has a buffer 3. Lifting mechanism drums 4 lift and lower the load suspension device via lifting mechanism cables 7. The lifting mechanism

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cables 7 are fixed via deflection rollers 8 on the crab frame and on fixing points on the device head 10 so that the load suspension device can be raised and lowered without swinging excessively. For cables hanging from crab 5, a cable trap 9 is fitted to the device head 10. Device head 10 is a frame which has fixing points 11 to which the cables 7 are attached. The fine positioning device 12 comprises a top section 13 and a bottom section 14. Between the device head and the superfine positioning device 12 is a rigid connection 15. The superfine positioning device 12 is connected to the spreader 16 via the spreader structure 17, on each corner of which a video camera 20 is fitted. The field of view of this video camera 20 covers the corners of the container 18 under the spreader 16.

Once the spreader has been lowered, without excessive swing, by the lifting mechanism drums 4 close enough to the container to be captured, an x/y direction and twist correction is carried out during which the top section 13 and bottom section 14 of the superfine positioning device move against each other. The degree of movement is controlled by computer using the image from the camera 20. Once the position has been correspondingly set, the twist locks 19 on the spreader 16 are lowered and locked onto the corners of the container 22.

Figure 2 shows the spreader extended 20b and retracted 20a with its camera over a container 18. To prevent the spreader colliding with other containers 18 or the warehouse walls, capture installations 28 can be fitted on the spreader which send 27 signals in a control field to a supervisory installation. The capture installations 28 are lasers. However, surveillance cameras and other suitable installations such as ultrasound are also possible.

Figure 4 shows the device per the invention in a simplified form with a rubber buffer 29 and a flexibly sprung wheel 30 on a spreader 16.

Figure 5 shows a system in which the normal working extension of the spreader is captured. With a capture device 25 fitted

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on the crab 5, the deviation of a target mark 26' from a reference target mark 26 is captured and passed on to a computer. This installation is used to locate the spreader 16, moved with little swing, precisely during and following its lowering onto the container 18 and to correct any x/y direction or twist deviations of crab 5 and bridge 2, or to take account of them during fine positioning.

Figures 6, 7 and 8 show in simplified form various arrangements of cameras 20 to capture the container corners 22.

Figure 9 shows a positioning installation for containers with hydraulic cylinders (31), via which levers (32) are pretensioned, on which the lifting mechanism cables (7) are fitted and via which the correct pretensioning or release of the cables (7) prevents the swinging of the load suspension device (10). To this end, accordingly, as illustrated in fig. 9, two corresponding cable fixing points are moved necessarily in opposite directions. The necessary adjustment of the cylinder drive is computer controlled.

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List of references used

	1	Crane track support	26	Reference mark
	2	Bridge	26'	Reference mark,
5		extended		
	3	Bridge buffer	27	Control field
	4	Lifting mechanism drum	28	Capture installation
	5	Crab	29	Rubber buffer
	6	Running wheel	30	Flexibly sprung wheel
10	7	Lifting mechanism cable	31	Hydraulic cylinder
	8	Deflection roller on crab	32	Lever (rocker)
		frame		
	9	Trap for cable		
	10	Load suspension device head		
15	11	Fixing point on device head		
	12	Superfine positioning device		
	13	Superfine positioning device		
		Top section		
	14	Superfine positioning device		
20		Bottom section		
	15	Rigid connection between device head		
		and superfine positioning device		
	16	Spreader		
	16'	Spreader extended		
25	17	Spreader structure		
	18	Container		
	19	Twist lock		
	20	Camera		
	20a	Camera on retracted spreader		
30	20b	Camera on extended spreader		
	21	Mirror		
	22	Container corner		
	23	Flexible mounting		
	24	Telescopic camera installation		
35	25	Installation on crab 5 for		
		detection of reference mark 26		

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Patent claims

- 5 1. Device for the accurate positioning and stacking of
 vessels, comprising a crane with a low-swing cable shaft
 between the crab (5) and a load suspension device head
 (10), a load suspension device (16), at least one sensor
 system (20) to detect the position of a vessel (18), a
10 fine positioning device (12, 13, 14) on the load
 suspension device (16) and a computer unit which controls
 the automatic operation of the device.
- 15 2. Device per claim 1, characterised by the fact that an
 image detection installation is used as the sensory
 system (20) to detect the position of the container (18).
- 20 3. Device per claim 2, characterised by the fact that a
 video camera is used as the image detection installation
 (20).
- 25 4. Device per claims 1 to 3, characterised by the fact that
 the video camera (20) is fitted on the load suspension
 device (16) and the optical capture of the position of
 vessels (22) is possible via a mirror (21).
- 30 5. Device per claims 1 to 3, characterised by the fact that
 a video camera (20) is fitted on the spreader (16) for
 monitoring purposes at least for each corner (22) of the
 container (18).
- 35 6. Device per claims 1 to 3, characterised by the fact that
 the camera (20) is fitted to a telescopic device (24) on
 the spreader (16).
7. Device per claims 1 to 3, characterised by the fact that
 the camera (20) is fitted on one side of the spreader
 (16).

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8. Device per claims 1 to 3, characterised by the fact that a device (28) is fitted on the spreader (16) to capture collision hazards.
- 5 9. Device per claims 1 to 3, characterised by the fact that an installation (25) is fitted on the crab (5) to detect a target mark (26, 26') on the spreader (16) for deviation detection.
- 10 10. Device per claims 1 to 3, characterised by the fact that the video camera (20) is flexibly mounted and attached (23).
- 15 11. Device per claims 1 to 3, characterised by the fact that anti-collision installations (28, 29) are fitted on the spreader (16).
- 20 12. Device per claim 1, characterised by the fact that hydraulic cylinders (31) are fitted on the cables (7) such that the cable tension can be changed by extending or retracting the cylinders (31), thus preventing any swing of the load suspension device head (10).

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